STATE OF VERMONT
AGENCY OF TRANSPORTATION

Scoping Report

FOR

Ludlow STP DECK(39)

VT 100, BRIDGE 99 OVER BRANCH BROOK

March 7, 2016

Table of Contents

I. Site Information

Bridge 99 is a State owned bridge located on VT 100 at the intersection of VT 103 in the town of Ludlow VT. The existing conditions were gathered from a combination of a Site Visit, the Inspection Report, the Route Log and the existing Survey. See correspondence in the Appendix for more detailed information.

Roadway Classification	Minor Arterial
Bridge Type	Rolled Beam
Bridge Length	82 feet
Year Built	1966
Ownership	State Owned

Need
The following is a list of deficiencies of Bridge 31:

1. The deck is rated a 5 Fair and is delaminating in several locations.

2. The width of the bridge could be increased to improve turning movements for large trucks.

Traffic

As stated above, Bridge 31 is located along VT 100 at the intersection of VT 103. Both of these roadway segments receive a moderate amount of traffic. To provide a better understanding of the impacts from various traffic of maintenance strategies including phased construction and a short term closure, VTrans hired a consultant engineering firm to perform a traffic analysis that considers daily traffic volumes, peak flows and truck traffic. The results of their analysis can be found in the Maintenance of Traffic section under Option 2: Phasing.

Design Criteria

The design standards for this roadway are indicated below; however given this is a maintenance project some improvements to meet current design standards will be impractical.

1. AASHTO. *A Policy on Geometric Design of Highways and Streets.* Association of State Highway and Transportation Officials, Washington, DC, 2011. (The Green Book)

2. AASHTO. *Roadside Design Guide.* Association of State Highway and Transportation Officials, Washington, DC, 2011.

Minimum standards are based on commentary from the Vermont State Design Standards for Lane and Shoulder widths for Urban Collectors.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Bridge Lane and Shoulder Widths	Green Book Chapter 8.2	3’-14’-14’-3’	5’-11’-11’-5’	Exceeds Min Standard
Speed		40 mph (Posted)	40 mph (Design)	
Bicycle/Pedestrian Criteria				6’ Shoulder Provided
Bridge Railing	Structures Design Manual Section 13		TL-2	

Inspection Report Summary

Deck Rating	5 Fair
Superstructure Rating	7 Good
Substructure Rating	7 Good

6/15/2015 Deck soffit continues to deteriorate at a slow pace & recent pavement & plug joint installation in 2013 will slow down deterioration progress. Heavy deterioration along outer ends of 3 of the backwall corners need repairs as deterioration has gone through and material is coming through Damage approach rail along VT 155side needs repairs. MJK SP

6/20/13 Deck soffit continues to deteriorate with large delams & spalls. Outer back wall in 3 location have heavy spalling which is allowing material to filter through. South approach rail needs repairs. MJK SH SP

5/24/11 Deck continue to deteriorate along bays 2 & 3 with areas of heavy saturation and large delams and some exposed rebar, saturation is also along each approach in all bays. Heavy break up of backwall southeast corner needs to be repaired as undermining is occurring beneath approach slab and a moderate size hole is present in concrete curb behind granite faced. Deck should be replaced as steel and abutments are in good shape except mentioned backwall above. MK DK

Utilities
The existing utilities are as follows:

Municipal Utilities

- N/A

Public Utilities

- N/A

Aerial:

- There are aerial electric and telephone facilities which run along Route 103 well out of the way. They are owned by Ludlow Electric, Ludlow TDS, Vermont Telephone, and Comcast.

It is not anticipated that overhead utilities will need to be relocated for construction.

Right Of Way
The existing Right-of-Way is plotted on the Layout Sheet. No additional Right-of-Way acquisition will be necessary.

II. Alternatives Discussion

This project was identified by Asset Management along with 9 other structure as candidate for the 2016/2017 Bridge Deck Replacement Program. The objective of the program was to identify structures to apply a cost-effective treatment at the proper time to preserve and extend the useful life of the bridge. Preventative maintenance provides the biggest benefit for the smallest level of investment. By either repairing or replacing the bridge deck, the service life of the superstructure and substructure can be maximized by protecting them from exposure to the elements that have

caused the deck to deteriorate to its current condition. Therefore, the alternatives analysis was limited to the bridge deck exclusively.

Alternative 1: No Action

This alternative leaves the bridge in its current condition. A good rule of thumb for the "No Action" alternative is to determine whether the existing bridge can stay in place without any work being performed on it during the next 10 years. Given the 'fair' rating on the deck, this bridge will require work within the next 10 years. From the standpoint of safety and economics this alternative is not recommended and will not be considered further.

Alternative 2: Deck Patching

The existing deck is rated as a 5 ("fair"). The superstructure, referring to the steel beams, is rated a 7 ("good"), and the existing substructure is rated a 7 ("good"). Deck patching would include removal of loose and deteriorating concrete, cleaning and possibly supplementing reinforcing steel, application of patching materials to cracks and areas of section loss, and paving on the bridge and for a short distance on each approach to the bridge. Some characteristics of deck patching are as follows:

- Patching tends to accelerate the deterioration of the existing concrete that is contact with the patching material, and thus offers a widely variable service life often 10 years or less.
- Much of the work would take place underneath the bridge with efforts required to avoid contamination of the river.
- In approximately 10 years, the condition of the bridge would be similar to its current condition and major work would be required again.

Disadvantages seem to outweigh the benefits to this short-term fix. Deck patching alone will not be considered further.

Alternative 3: Deck Replacement

This alternative would involve removing the existing deck in its entirety and placing a new deck on the existing steel beams. In addition to replacing the bridge deck, some repair work on the curtain walls between the wingwall and exterior girders will be required.

The existing substructure is in good condition, and it is reasonable to assume that it can safely carry anticipated traffic loads for an additional 40 years. Therefor no repairs would be recommended to the existing substructure at this time.

Advantages: This alternative will protect the superstructure for years to come from exposure to the elements which have deteriorated the deck. This option would also have minimal impacts to adjacent properties and resources.

Maintenance of Traffic: Traffic could be maintained on an offsite detour or with phased construction. It generally does not make economic sense to construct a temporary bridge for a rehabilitation project.

Given this is a maintenance project meeting new design standards may not be possible. However the scope of the project will be to improve the bridge as much as possible given the site constraints.

III. Maintenance of Traffic

The Vermont Agency of Transportation reviews each new project to determine suitability for the Accelerated Bridge Program, which focuses on faster delivery of construction plans, permitting, Right-of-Way, and faster construction of projects in the field. One practice that helps this endeavor is to close bridges for portions of the construction period, rather than provide temporary bridges. In addition to saving money, the intention is to minimize the closure period with faster construction techniques and incentives to contractors to complete projects sooner. The Agency will consider the closure option on most projects where rapid reconstruction or rehabilitation is feasible. The use of prefabricated elements in new bridges also expedites construction schedules. This can apply to decks, superstructures, and substructures. Accelerated bridge construction and short term road closures creates a safer working environment for construction personnel while minimizing traffic impacts. The following maintenance of traffic options have been considered:

Option 1: Off-Site Detour

Ludlow Bridge 99:
This option would close the bridge and reroute traffic onto an offsite detour. Since the bridge is located on a State Highway, the State will design and manage a detour route and traffic control plan. The State will coordinate with emergency services to develop a plan for the closure period. The detour options the State will sign are shown in the appendices. The shortest available state detour routes are as follows:

1. From the intersection of VT 103 and VT 100 travel North on VT 100 for approximately 8.5 miles, turn right onto VT 100A travel North for approximately 7 miles, turn right onto US Route 4 travel east for approximately 8 miles, turn right onto VT 106 travel south for approximately 18 miles, turn right onto VT 131 travel west for approximately 9 miles, turn right onto 103 travel north for approximately 4.5 miles. The end to end distance is 55 miles and takes 1 hour and 20 minutes to travel.

2. From the intersection of VT 103 and VT 100 travel North on VT 103 for approximately 17.5 miles, turn right onto US Route 7 travel north approximately 5 miles, turn right onto US Route 4 travel east for approximately 17 miles, turn right onto VT 100 travel south for approximately 14 miles. The end to end distance is 53.5 miles and takes 1 hours and 10 minutes to travel.

A potential local bypass route is as follows:

1. From the intersection of VT 103 and VT 100 travel North on VT 100 for approximately 0.5 miles, turn left onto Rod & Gun Club rd, travel to the end turn left onto Buttermilk Falls Rd, travel to the end of Buttermilk Falls Rd. The end to end distance is approximately 2 miles and takes 7 minutes to travel.

Advantages: The costs associated with signing the detour are much lower than the construction costs associated with other maintenance of traffic options. By detouring traffic away from construction activities, it creates a safer working environment for the construction workers. By not constructing the structure in phases, there will be no vibrations or deflections from adjacent traffic to affect the quality of the closure pours joining the phases. By not requiring the construction and removal of temporary approaches, temporary bridges and temporary crossovers, the length of construction can be reduced over those other options. This is the safest traffic control option since the traveling public is removed from the construction site.

Disadvantages: Traffic will not be maintained along the existing corridor for a limited portion of construction. Through traffic will see an increase in travel times during the closure period.

Option 2: Phasing

Phased construction is the maintenance of one way alternating traffic on the existing bridge while building one lane at a time of the proposed structure. This allows the road to stay open to traffic during construction with regular construction related delays, while having minimal impacts to adjacent property and environmental resources.

Advantages: Traffic would be maintained along the existing corridor during construction.

Disadvantages: While the time and cost required to construct a phased project may be less than that required to construct a project with a temporary bridge, the time required to construct a phased construction project is still longer than a project constructed without phasing, because some of the construction tasks have to be performed multiple times and cannot be performed concurrently. The costs of construction also increases over un-phased work because of this increase in the length of time, the additional inconvenience of working around traffic, and the effort involved in coordinating the joints between the phases. Once again, while the corridor will be open to traffic during construction, traffic will still be delayed and disrupted by the reduction in the number of lanes and by construction vehicles and equipment entering and exiting the site. The construction workers and equipment will still be in close proximity to vehicular traffic increasing the probability of accidents.

Given the proximity of the bridge to the intersection of VT 100/103 and moderate traffic volumes, any MOT strategy will have significant traffic impacts resulting in travel delays. In low volume intersections the reduced capacity of the intersection has very little impact to the traveling public because each leg is able to clear during each green light. With higher volumes, intersections ques (lines of cars) can begin to back up as motorists may have to wait for 1, 2 or even 3 cycles (green lights) before they are allowed to proceed through the intersection. In order to determine if phasing is feasible with reasonable traffic delays, VTrans hired a consulting engineering firm to perform an analysis for the phased construction traffic condition. The analysis indicated that the alternating one way traffic option would be feasible with a reasonable level of delay and que lengths. Based on the analysis "reasonable" means that the intersection is not over capacity and that delays and ques are acceptable for a temporary condition such as construction. The traffic volume projections and analyses can be seen in the appendices under "Phased Construction Evaluation".

Option 3: Temporary Bridge

Given this is a maintenance project a temporary bridge was not considered to be cost effective for maintenance and was not evaluated.

Maintenance of Traffic Conclusion

Ludlow Bridge 99:
Since the traffic analysis concluded that a reasonable level of service could be achieved through phased construction along with an unreasonable length of the detour route, phased construction is recommended. Therefore the recommendation is to utilize temporary signals to maintain one way alternating traffic and construct the new deck in phases.

IV. Cost Matrix[1]

Ludlow B99 VT 100		Do Nothing	**Alt 1** Deck Replacement
			a. Accelerated
COST	Bridge Cost	$0	$197,000
	Removal of Structure	$0	$66,000
	Roadway	$0	$210,000
	Maintenance of Traffic	$0	$180,000
	Construction Costs	$0	$653,000
	Construction Engineering + Contingencies	$0	$195,900
	Total Construction Costs w CEC	**$0**	**$848,900**
	Preliminary Engineering[2]	**$0**	**$100,000**
	Right of Way	**$0**	**$0**
	Total Project Costs	$0	$948,900
	Annualized Costs	$0	$0
TOWN SHARE	Towns total Share (0%)	**N/A**	**N/A**
SCHEDULING	Project Development Duration[3]		2 years
	Construction Duration		1 years
	Closure Duration (If Applicable)		
ENGINEERING	Typical Section –		
	Typical Section –		
	Typical Section – Bridge (feet)	3’-14’-14’-3’ (34’)	6’-11’-11’-6’ (34)
	Geometric Design Criteria	No Change	No Change
	Traffic Safety	No Change	No Change
	Alignment Change	No Change	No Change
	Bicycle Access	No Change	No Change
	Vertical Clearance	No Change	No Change
	Pedestrian Access	No Change	No Change
	Utility	No Change	No Change
OTHER	ROW Acquisition	No	No
	Road Closure	No	No
	Design Life	<10 years	30-40 years

[1] Costs are estimates only, used for comparison purposes.
[2] Preliminary Engineering costs are estimated starting from the end of the Project Definition Phase.
[3] Project Development Durations are starting from the end of the Project Definition Phase.

V. Conclusion

Alternative 3 is recommended; to replace the existing deck using phased construction.

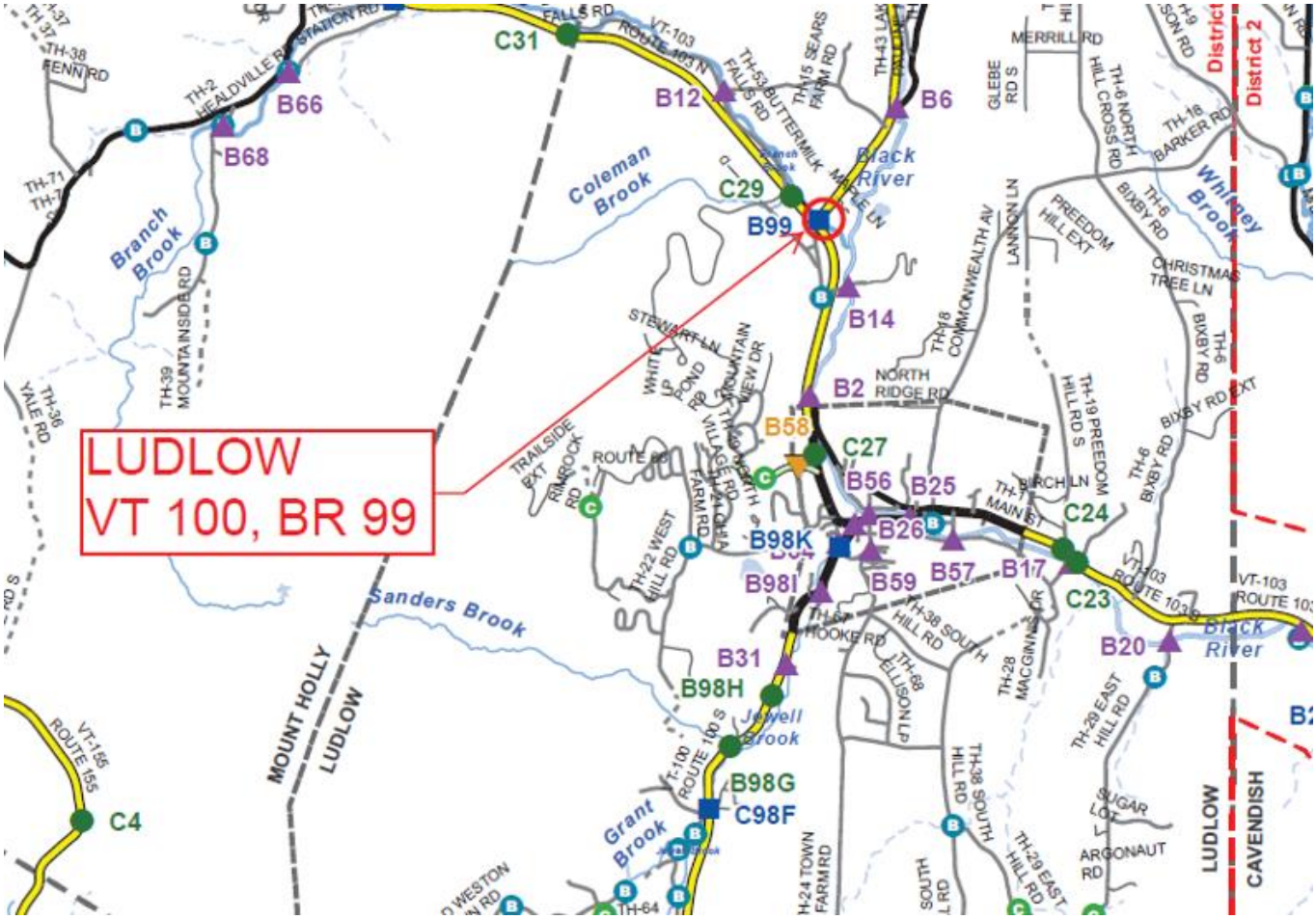
This alternative includes replacing the deck with full depth precast concrete deck panels. By using prefabricated bridge components, the amount of time to replace the bridge deck will be dramatically reduced limiting the duration of alternating one-way traffic condition and associated impacts to the traveling public. In order to further reduce construction costs and associated traffic impacts, VTrans is bundling this project with a signal project that was already planned for the 2017 construction season. By combining the projects under one contract, coordination of construction activities associated with the bridge and intersection improvements become much easier and construction costs are reduced.

Traffic Maintenance:
The State of Vermont will include provisions in the contract that require the contractor to sign and maintain the traffic control required to safely move traffic through the construction site.

VI. Appendices

Site Pictures

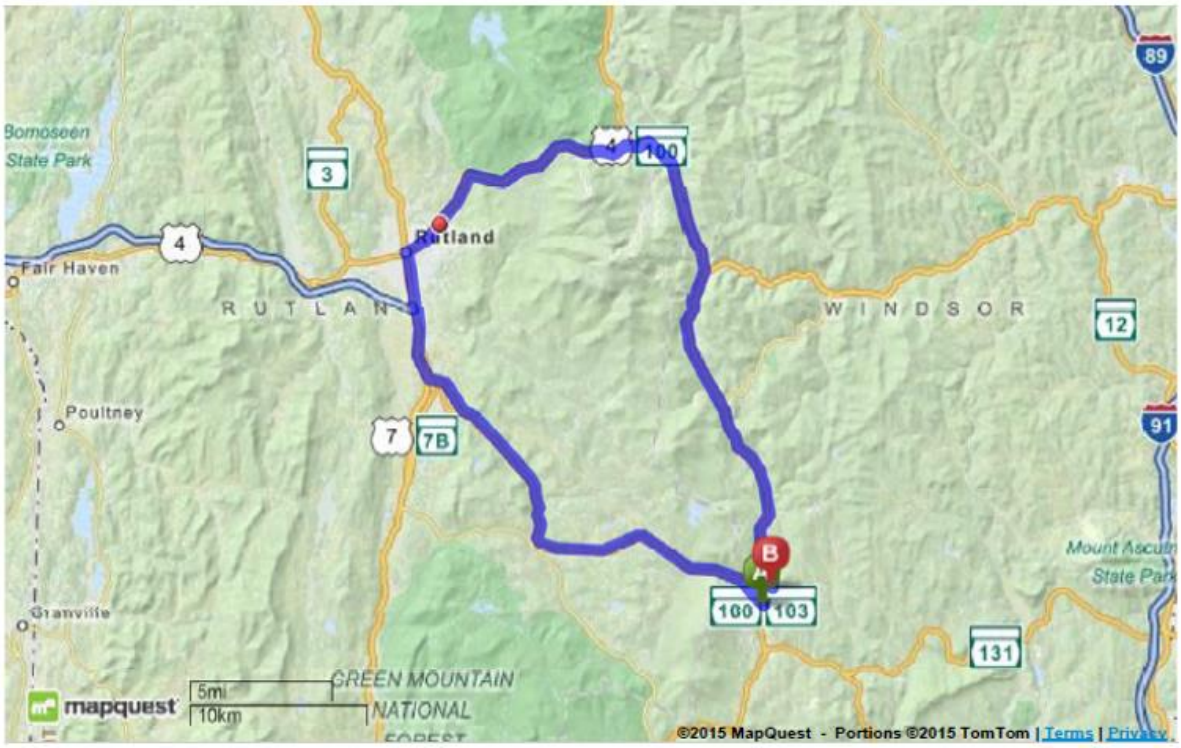
Town Map


LUDLOW
VT 100, BR 99
C31
B12
B6
B66
B68
C29
B99
B14
B2
B58
C27
B56
B25
B26
B98K
B98I
B59
B57
B17
C24
C23
B20
B31
B98H
B98G
C98F
C4
Coleman Brook
Branch Brook
Sanders Brook
Jewell Brook
Grant Brook
Black River
Whitney Brook
MOUNT HOLLY
LUDLOW
CAVENDISH
District 2
VT-103 ROUTE 103 N
VT-100 ROUTE 100 S
VT-155 ROUTE 155
MERRILL RD
FALLS RD
BUTTERMILK FALLS RD
TH-15 SEARS FARM RD
TH-43 LAKE RD
GLEBE RD S
TH-6 NORTH HILL CROSS RD
TH-18 BARKER RD
PREEDOM HILL EXT
TH-6 BIXBY RD
CHRISTMAS TREE LN
BIXBY RD EXT
LANNON LN
COMMONWEALTH AV
NORTH RIDGE RD
TH-19 PREEDOM HILL RD S
BIRCH LN
TH-1 MAIN ST
TH-22 WEST HILL RD
TH-24 TOWN FARM RD
TH-38 SOUTH HILL RD
TH-68 ELLISON LN
TH-28 MACGINNIS DR
TH-29 EAST HILL RD
SUGAR LOT
ARGONAUT RD
TH-64
TH-2 HEALDVILLE RD
TH-37
TH-38 PENN RD
TH-71
TH-39 MOUNTAINSIDE RD
TH-36 VALE RD
STEWART LN
WHITE POND RD
MOUNTAIN VIEW DR
TRAILSIDE EXT
RIMROCK RD
ROUTE 100
VILLAGE GREEN
FARM RD
HOOKE RD
MEADOW LN
SOUTH HILL RD
WESTON RD

Detour

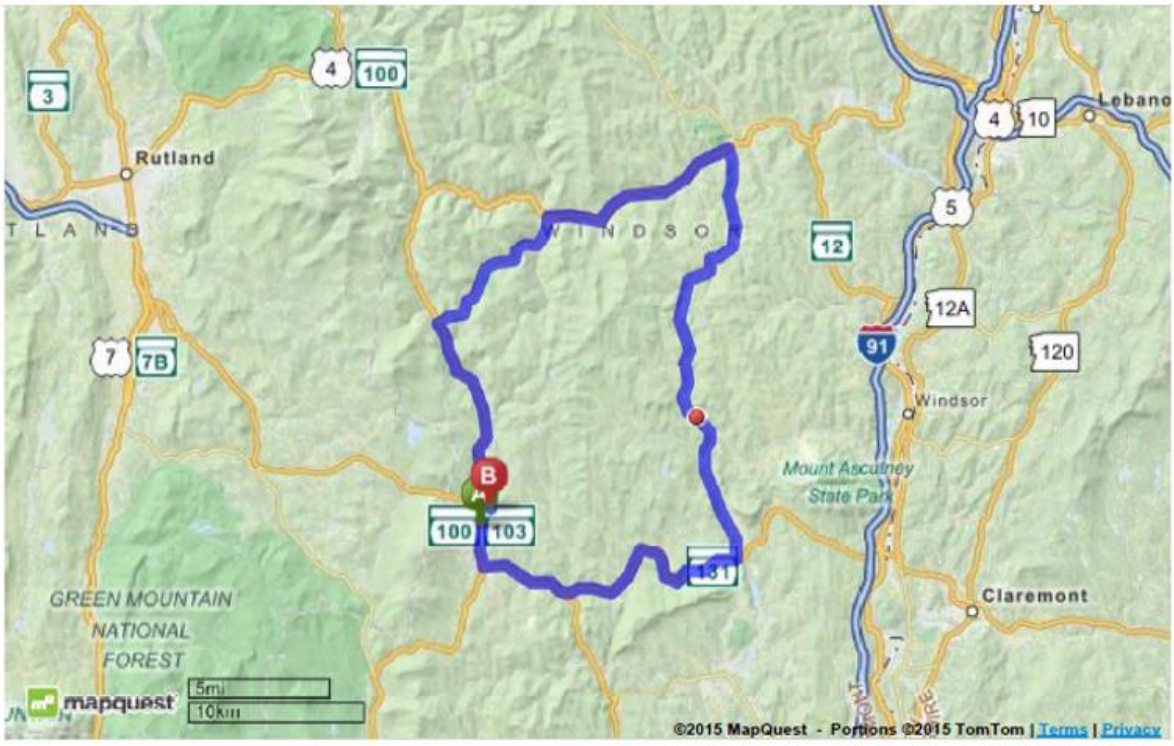
Alternative 1:

Total Travel Estimate: **53.09 miles - about 1 hour 8 minutes**



Alternative 2:

Total Travel Estimate: **54.88 miles - about 1 hour 17 minutes**



Bridge Inspection Report

STRUCTURE INSPECTION, INVENTORY and APPRAISAL SHEET

Vermont Agency of Transportation – Structures Section – Bridge Management and Inspection Unit

Inspection Report for LUDLOW | *bridge no.: 00099* | *District: 3*

Located on: VT 00100 ML ove BRANCH BROOK | *approximately 0.1 MI N JCT. VT.103 N* | *Owner: 01 STATE-OWNED*

CONDITION

Deck Rating: 5 FAIR

Superstructure Rating: 7 GOOD

Substructure Rating: 7 GOOD

Channel Rating: 8 VERY GOOD

Culvert Rating: N NOT APPLICABLE

Federal Str. Number: 200013009914102

Federal Sufficiency Rating: 082.5

Deficiency Status of Structure: ND

AGE and SERVICE

Year Built: 1966 Year Reconstructed: 0000

Service On: 1 HIGHWAY

Service Under: 5 WATERWAY

Lanes On the Structure: 02

Lanes Under the Structure: 00

Bypass, Detour Length (miles): 36

ADT: 003500 % Truck ADT: 09

Year of ADT: 1998

GEOMETRIC DATA

Length of Maximum Span (ft): 0082

Structure Length (ft): 000084

Lt Curb/Sidewalk Width (ft): 0.5

Rt Curb/Sidewalk Width (ft): 0.5

Bridge Rdwy Width Curb-to-Curb (ft): 34

Deck Width Out-to-Out (ft): 39.1

Appr. Roadway Width (ft): 039

Skew: 00

Bridge Median: 0 NO MEDIAN

Min Vertical Clr Over (ft): 99 FT 99 IN

Feature Under: FEATURE NOT A HIGHWAY OR RAILROAD

Min Vertical Underclr (ft): 00 FT 00 IN

STRUCTURE TYPE and MATERIALS

Bridge Type: ROLLED BEAM

Number of Approach Spans 0000 | *Number of Main Spans: 001*

Kind of Material and/or Design: 3 STEEL

Deck Structure Type: 1 CONCRETE CIP

Type of Wearing Surface: 6 BITUMINOUS

Type of Membrane 2 PREFORMED FABRIC

Deck Protection: 0 NONE

APPRAISAL *AS COMPARED TO FEDERAL STANDARDS

Bridge Railings: 1 MEETS CURRENT STANDARD

Transitions: 1 MEETS CURRENT STANDARD

Approach Guardrail 1 MEETS CURRENT STANDARD

Approach Guardrail Ends: 1 MEETS CURRENT STANDARD

Structural Evaluation: 7 BETTER THAN MINIMUM CRITERIA

Deck Geometry: 5 BETTER THAN MINIMUM TOLERABLE CRITERIA

Underclearances Vertical and Horizontal: N NOT APPLICABLE

Waterway Adequacy: 7 SLIGHT CHANCE OF OVERTOPPING BRIDGE & ROADWAY

Approach Roadway Alignment: 8 EQUAL TO DESIRABLE CRITERIA

Scour Critical Bridges: 8 STABLE FOR SCOUR

DESIGN VEHICLE, RATING, and POSTING

Load Rating Method (Inv): 1 LOAD FACTOR (LF)

Posting Status: A OPEN, NO RESTRICTION

Bridge Posting: 5 NO POSTING REQUIRED

Load Posting: 10 NO LOAD POSTING SIGNS ARE NEEDED

Posted Vehicle: POSTING NOT REQUIRED

Posted Weight (tons):

Design Load: 4 H 20

INSPECTION and CROSS REFERENCE

X-Ref. Route:

Insp. Date: 062015 | *Insp. Freq. (months) 24* | *X-Ref. BrNum:*

INSPECTION SUMMARY and NEEDS

06/15/15 Deck soffit continue to deteriorate at a slow pace & recent pavement & plug joint installation in 2013 will slow down deterioration progress. Heavy deterioration along outer ends of 3 of the backwall corners need repairs as deterioration has gone through and material is coming through Damage approach rail along VT155 side needs repairs. MJK SP

06/20/13 Deck soffit continue to deteriorate with large delams & spalls. Outer back wall in 3 location have heavy spalling which is allowing material to filter through. South approach rail need repairs. MJK SH SP

5/24/11 Deck continue to deteriorate along bays 2 & 3 with areas of heavy saturation and large delams and some exposed rebar, saturation is also along each approach in all bays. Heavy break up of backwall southeast corner needs to be repaired as undermining is occurring beneath approach slab and a moderate size hole is present in concrete curb behind granite faced. Deck should be replaced as steel and abutments are in good shape except mentioned backwall above. MK DK

05/15/2009 The overall condition of this bridge is satisfactory, except for slow ongoing breakdown of the deck soffit area, especially in bays 2 and 3, and

Friday, July 10, 2015

Phased Construction Evaluation

540 Commercial Street Manchester, NH 03101
(603) 668-8223 • Fax: (603) 668-8802
cld@cldengineers.com • www.cldengineers.com
New Hampshire • Vermont • Maine

TO: File.

FROM: Paul Konieczka, AICP PK

DATE: October 20, 2015

RE: VTrans Contract No. PS0382
Deck Replacement - Ludlow – VT 100
Alternating One-Way Traffic Feasibility Evaluation
CLD Reference No. 15-0223.4200

Purpose

The purpose of this analysis was to evaluate the feasibility of providing an alternating one-way traffic control option with temporary signals at the intersection of VT 100/103 for the deck replacement on the adjacent bridge. Initial thoughts from the Department were that the volumes were too high to make this a viable alternative.

In summary, this analysis appears to indicate that the alternating 1-way traffic option would be feasible at a reasonable level of delay and queueing.

Traffic Volume Projections and Analyses

12-hour turning movement counts at the unsignalized intersection of VT 100/103 adjacent to the bridge were taken by VTrans in June 2012. VTrans historical counts and subsequent traffic growth factors for this roadway show little if any growth since 2012, so this analysis was conducted using the highest peak hour from the 2012 counts (3:30-4:30 pm) as a reasonable test.

The lane use on the divided VT 103 north-south approaches are a through lane and an exclusive turn lane (LT lane for the SB approach; RT lane for the NB approach) with a single lane from VT 100 crossing the bridge. This intersection layout should allow for a 3-phase temporary signal phasing operation, where the SB approach would go on Phase 1, the NB approach (plus the SB through movement since there is no conflicting NB left turn at the intersection) on Phase 2, and the bridge itself on Phase 3.

The temporary work zone on the bridge was assumed to require 250 feet, plus 60 feet to pass through the intersection, so the clearance time was based on a 310-foot work zone. At a 15 mph travel speed (22 ft/sec), this requires 14 seconds of All-Red time to allow for alternative one-way traffic. The higher speeds on VT 103 also require longer Yellow clearance times, so these were included as well.

The intersection was analyzed using the SYNCHRO software to optimize the cycle length and phase splits given the volumes and lane use. The results of the analyses show that an overall LOS 'D' can be provided under this 3-phase operation, with a cycle length of 110 seconds. The

which can be accommodated within the existing lane. The average queue lengths for all lane groups varied between 12-170 feet, or 1-7 vehicles. The SYNCHRO printouts are attached for information.

PK:pk

Attachments

- VTrans Turning Movement Count – PM Peak hour summary sheet 6/6/12
- SYNCHRO printouts – 2012 PM peak with alternating one-way traffic